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Exploring the synergistic potential of polyherbal formulations in traditional medicine: A comprehensive ethnopharmacological study in Gangachara upazila, Rangpur, Bangladesh

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Abstract

This study documents the ethnopharmacological practices of traditional medicinal practitioners (Kavirajes) in Gangachara Upazila, Rangpur, Bangladesh, focusing on the use of polyherbal formulations for treating various ailments. A randomized survey was conducted among two Kavirajes, documenting 33 plant species from 23 families used to treat 12 distinct health conditions, including allergic reactions, pox, abscess, paralysis, dysuria, diabetes, leucorrhoea, dysentery, jaundice, chronic bronchitis, asthma, and high blood pressure. The most frequently used plant families were Zingiberaceae, Lamiaceae, Acanthaceae, and Menispermaceae, with leaves being the predominant plant part utilized (65% of preparations). Polyherbal formulations were prepared as juices, pastes, decoctions, or tablets, often combining multiple plants to enhance therapeutic efficacy. For instance, Curcuma longa rhizome juice mixed with *Azadirachta indica* and *Clerodendrum infortunatum* leaves were used for allergic reactions, while *Nyctanthes arbor-tristis* and *Vitex negundo* leaves were combined for pox management. The study highlights the cultural and economic significance of traditional medicine in rural Bangladesh, where 80% of the population relies on natural resources for primary healthcare. Despite the lack of systematic documentation, the knowledge held by Kavirajes offers valuable insights for pharmacological research and drug discovery. This research underscores the need to preserve traditional ethnomedicinal knowledge and integrate it into modern healthcare systems, particularly in resource-limited settings.

Keywords: Ethnopharmacology; Medicinal Plants; Polyherbal Formulations; Synergistic Effects; Traditional Medicine

1. Introduction

Humans, as a biological species, have maintained a symbiotic relationship with plant and animal species throughout their evolutionary history. This interdependence is particularly evident in the reliance on plants for medicinal purposes, a practice documented across both ancient and modern civilizations. Since the emergence of *Homo sapiens*, the prevalence of diseases prompted early humans to experiment with natural resources including plants, animals, insects, and minerals as therapeutic agents [1]. Archaeological and historical evidence suggests that humans recognized the medicinal properties of plants as early as 5,000 years ago [2]. The systematic documentation of traditional ethnomedicinal knowledge remains critical for advancing pharmacological discoveries, as evidenced by the derivation of modern allopathic drugs such as morphine, quinine, and aspirin from plant-based sources.

The reliance on Folk Medicinal Practitioners, often referred to as Kaviraj, remains a cornerstone of healthcare in rural regions of many countries, particularly in areas marked by socioeconomic disparities. Empirical evidence suggests that

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this healthcare-seeking behavior is driven by a complex interplay of factors, including limited health literacy, restricted access to modern medical infrastructure, entrenched sociocultural norms, and financial constraints [3]. In underserved areas, populations often depend on Kaviraj due to structural inadequacies in formal healthcare systems, such as the scarcity of trained biomedical practitioners and geographical barriers to healthcare facilities. Cultural factors further exacerbate this trend, particularly gender-specific healthcare access challenges. For instance, social reticence among women to seek care from unfamiliar providers often limits their access to modern healthcare services [4]. Economic precarity also compels individuals to prioritize low-cost, community-embedded alternatives over formal medical services, which are often perceived as financially prohibitive [5].

Bangladesh, endowed with favorable agro-climatic conditions and pronounced seasonal diversity, is recognized for its rich genetic reservoir of medicinal plants. The country hosts approximately 6,500 plant species, including bryophytes, gymnosperms, pteridophytes, and angiosperms, of which 500 possess documented medicinal value [6]. Despite global advancements in healthcare, plants remain a cornerstone of disease management in Bangladesh, particularly in rural regions where 75% of the population resides (representing ~10 million households across 85,000 villages) [7]. An estimated 80% of rural communities depend on natural resources for primary healthcare [8], with herbal medicine retaining widespread acceptance as a cost-effective and culturally rooted therapeutic approach [9].

The medicinal landscape of Bangladesh is shaped by diverse traditional systems, including Ayurveda, Unani, Homeopathy, and folk/tribal medicine. Among these, Ayurveda and Unani are highly structured, with well-defined pharmacological formulations [8]. In contrast, folk medicine represents a dynamic, community-driven practice that integrates localized beliefs, empirical knowledge, and elements from established systems. Folk medicinal practitioners (*Kavirajes*) serve as pivotal healthcare providers in both rural and urban settings, relying predominantly on plant-based remedies. Their formulations often simple preparations such as juices, pastes, decoctions, or raw plant parts are tailored to individual patient needs [10]. Notably, the knowledge held by *Kavirajes* is typically guarded within practitioner lineages, posing challenges to systematic documentation despite its potential to inform global drug discovery and healthcare innovation.

This study focuses on Gangachara Upazila, the northernmost sub-district of Rangpur in northern Bangladesh. Although lacking extensive forest cover, the region sustains a diverse array of medicinal plants within homestead gardens, roadside vegetation, pond banks, and graveyards. To evaluate the ethnobotanical knowledge of local practitioners, a randomized survey was conducted among two folk medicinal practitioners (*Kavirajes*) in Gangachara. The study aimed to document plant species used, their therapeutic applications, and preparation methods, thereby contributing to the preservation of traditional knowledge and identifying potential candidates for pharmacological research.

This research topic focuses on investigating the therapeutic efficacy and synergistic effects of polyherbal formulations used by traditional medicinal practitioners (Kavirajes) in Gangachara Upazila, Rangpur, Bangladesh. The study aims to document, analyze, and validate the ethnopharmacological practices of local healers, with a particular emphasis on the combination of multiple medicinal plants to treat various ailments. By exploring the pharmacological mechanisms, cultural significance, and socioeconomic impact of these traditional remedies, the research seeks to bridge the gap between traditional knowledge and modern scientific validation, ultimately contributing to the development of cost-effective, culturally sensitive, and sustainable healthcare solutions for rural and underserved populations.

2. Material and methods

The present survey was carried out in different seasons of the year (2022) in two villages in Gangachara Upazila of Rangpur district, namely Moniram and Char Aani Sherpur. The main occupation of the villagers of these villages is agriculture. Kaviraj Md. Shamsul Alam practiced in Moniram village while Kaviraj Sree Jukto Babu Padar Chandra Roy practiced in Char Aani Sherpur village. From the two villages, 20 households were selected randomly for comprehensive study several visits were made to build up association with Headman, healer and other members of the two villages.

Prior informed consent was obtained Headman, Heads of households and adult members of two villages to interview them as to their traditional medicinal practices (healer). Interviews were conducted in Bengali language spoken by both kaviraj and the interviewers and the survey were conducted with the help of a semi-structured questionnaire and the guided field-walk method as described by Martin and Maundu [11]. Interviews were organized after receiving permission from the Kavirajes. The Kavirajes gave explanations of medicinal plants, information on the local name of plants, plant parts used for curing, preparation and formulation methods, dose, administration, precautions and time required for healing diseases were recorded properly. After finishing the interviews', collected information was cross-checked by the Kavirajes. Subsequently, plant specimens were collected and photographed serially, pressed and dried and preserved.

2.1. Study area

Gangachara Upazila (Rangpur district) area 272.28 sq km, located between 25°48' and 25°57' north latitudes and in between 89°05' and 89°21' east longitudes. It is bounded by Kaliganj (Lalmonirhat) and Jaldhaka Upazilas on the north, Rangpur sadar and Kaunia Upazilas on the south, Aditmari and Lalmonirhat sadar Upazilas on the east, Kishoreganj (Nilphamari) and Taraganj Upazilas on the west. The town is famous for its tobacco business.

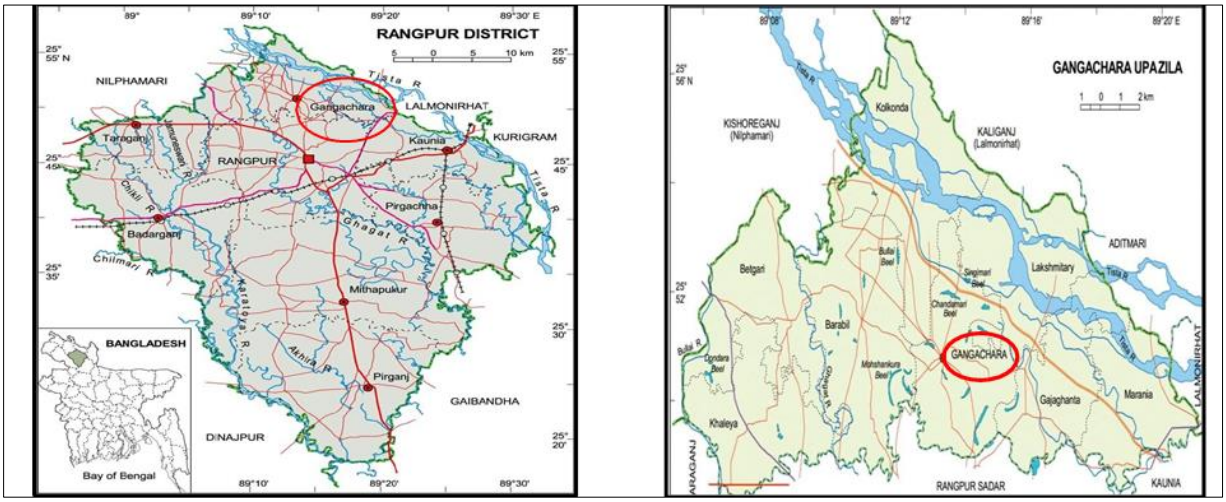

Figure 1 Map of Rangpur district showing the location of Gangachara Upazila

3. Results and discussion

Table 1 List of plants used in different ailments with their polyherbal formulation

Ailments	Scientific name	Family	Local name	Plants part used	Formulation
Allergic reaction	*Curcuma longa*	Zingiberaceae	Holud	Rhizome	Equal amounts of *Azadirachta indica A. Juss* and *Clerodendrum infortunatum* leaves were ground into a paste, then dried under sunlight to form tablets. Juice was extracted from the rhizome of Curcuma longa. Half a teaspoon of Curcuma longa juice was mixed with one tablet, which was taken orally on an empty stomach every morning and afternoon for 10 days.
	Clerodendrum infortunatum	Verbenaceae	Bhat	Leaf	
	Azadirachta indica	Meliaceae	Neem	Leaf	
Pox	*Nyctanthes arbor-tristis*	Oleaceae	Sheuli	Leaf	Equal amounts of *Azadirachta indica* and *Clerodendrum infortunatum* leaves were ground into a paste and dried under sunlight to form tablets. Juice was extracted from *Nyctanthes arbor-tristis and Vitex negundo* leaves in equal proportions. Half a cup of this juice was mixed with one tablet, which was taken orally in the morning and afternoon for 15 days.
	Vitex negundo	Lamiaceae	Nishinda	Leaf	
	Clerodendrum infortunatum	Verbenaceae	Bhat	Leaf	
	Azadirachta indica	Meliaceae	Neem	Leaf	
Abscess	*Sida acuta*	Malvaceae	Berela	Leaf	Equal amounts of banana tree (*Musa paradisiaca*) ash and calcium hydroxide were mixed into a paste, which was
	Musa paradisiaca	Musaceae	Banana	Fruit peel	

					applied as a layer over the abscess and then covered with a *Sida acuta* leaf.
Paralysis	*Justicia gendarussa*	Acanthaceae	Bish-dorun	Leaf	Equal amounts of *Justicia gendarussa* leaves, *Cissus quadrangularis* leaves and stems, and *Zingiber officinale* rhizomes were ground into a paste and applied to the affected area once daily for 30 days.
	Cissus quadrangularis	Vitaceae	Harjora	Stem	
	Zingiber officinale	Zingiberaceae	Aada	Rhizome	
Dysuria	*Smilax sp.*	Smilacaceae	Panimutari	Leaf	Equal amounts of *Smilax* sp. and *Bryophyllum pinnatum* leaves were crushed into a paste to extract the juice. Four teaspoons of the juice were taken orally in the morning and afternoon for 7 days.
	Bryophyllum pinnatum	Crassulaceae	Patharkuchi	Leaf	
Diabetes	*Tinospora sinensis*	Menispermaceae	Gultai	Leaf	Equal amounts of *Tinospora sinensis*, *Ficus racemosa* and *Momordica charantia* leaves were crushed into a paste to extract the juice. One teaspoon of the juice was taken on an empty stomach in the morning and afternoon.
	Momordica charantia	Cucurbitaceae	Karala	Leaf	
	Ficus racemosa	Moraceae	Dumur	Leaf	
Leucorrhoea	*Stephania japonica*	Menispermaceae	Akond	Leaf	*Stephania japonica* and *Amaranthus spinosus* leaves were crushed to extract the juice, which was taken twice daily on an empty stomach for 15 days.
	Amaranthus spinosus	Amaranthaceae	Katanote	Leaf	
Dysentery	*Cynodon dactylon*	Poaceae	Durva ghash	Leaf	*Cynodon dactylon*, *Stephania japonica*, *Centella asiatica*, and *Litsea glutinosa* were crushed into a paste-like texture, while the whole plant of *Mimosa pudica* was crushed separately to extract its juice. Both were mixed to form a suspension-like solution, which was taken in the morning for 3 days.
	Stephania japonica	Menispermaceae	Akond	Leaf	
	Centella asiatica	Apiaceae	Thankuni	Leaf	
	Mimosa pudica	Mimosaceae	Lajjaboti	Whole plant	
	Litsea glutinosa	Lauraceae	Kukurchita	Leaf	
Jaundice	*Achyranthes aspera*	Amaranthaceae	Ubatlengra	Branch	Equal amounts of *Streblus asper* and *Piper longum* leaves were made into a paste to extract the juice. 125 ml of the juice was mixed with a glass of water and taken on an empty stomach in the morning and afternoon for 7 days.
	Streblus asper	Moraceae	Shawra	Leaf	
	Piper longum	Piperaceae	Pipul	Leaf	
Chronic bronchitis	*Ocimum tenuiflorum*	Lamiaceae	Tulsi	Leaf	*Ocimum tenuiflorum*, *Zingiber officinale* and a pinch of *Nigella sativa* were taken to prepare juice and taken orally with mustard oil for adults and honey for child
	Nigella sativa	Ranunculaceae	Kalo jeera	Seeds	
	Zingiber officinale	Zingiberaceae	Ginger	Rhizome	
Asthma	*Justicia adhatoda*	Acanthaceae	Bashak	Leaf	Equal amount of *Justicia adhatoda* and *Clerodendrum serratum* were taken and boiled, and taken for 30 days in the morning daily
	Clerodendrum serratum	Lamiaceae	Bhant	Root	

High Blood Pressure	*Catharanthus roseus*	Apocynaceae	Nayantara	Leaf	*Catharanthus roseus* and *Musa paradisiaca* are ground together to form a semi-solid gel-like mixture, which is then combined with *Aegle marmelos* fruit. This formulation is recommended to be taken twice a week for a duration of three months.
	Aegle marmelos	Rutaceae	Bael	Fruit	
	Musa paradisiaca	Musaceae	Kola	Fruit peel	

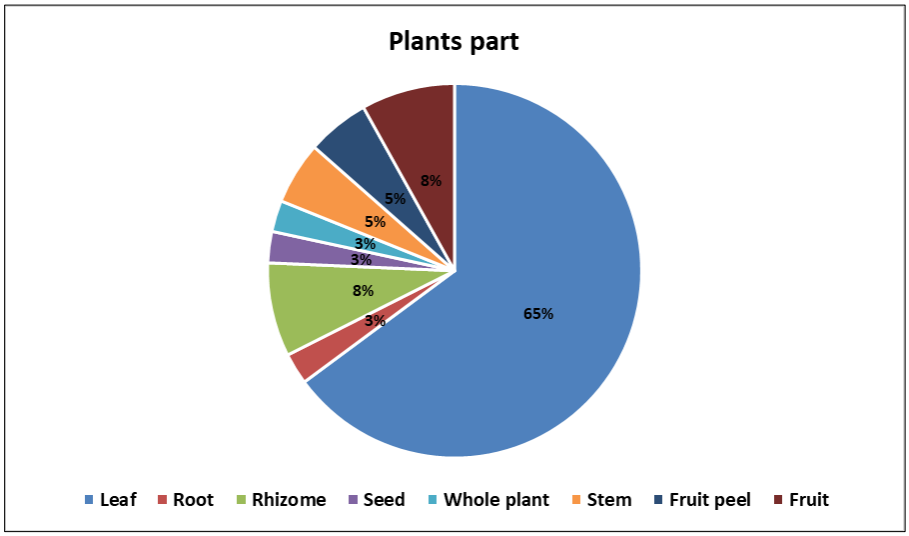

Figure 2 Distribution of plants part used

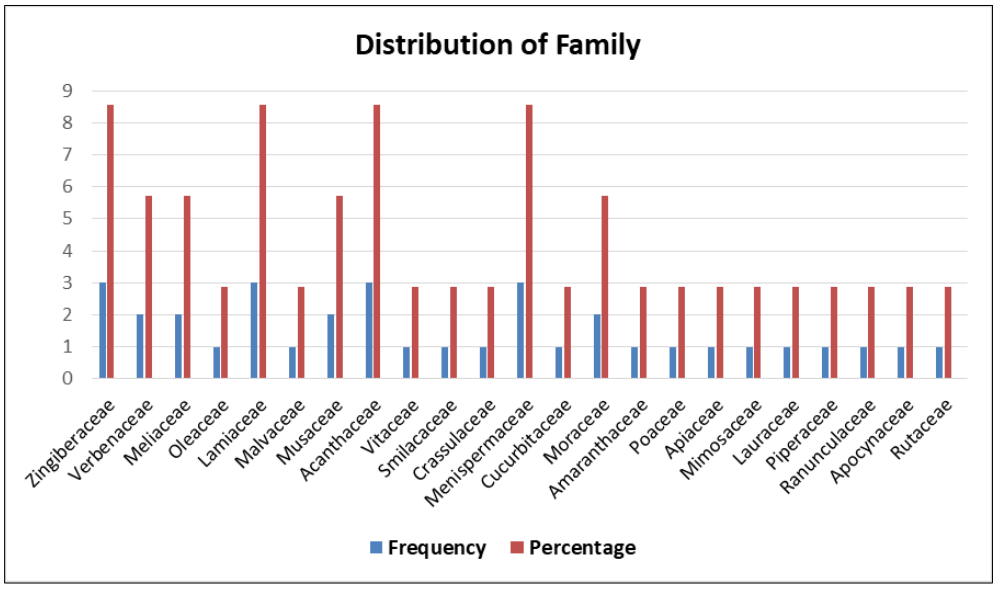

Figure 3 Distribution of family

3.1. Ethnopharmacological Utilization of Medicinal Plants

This study documents the ethnopharmacological utilization of 33 plant species, belonging to 23 distinct botanical families, for the treatment of 12 distinct ailments. All therapeutic applications involve polyherbal formulations, reflecting the traditional practice of combining multiple plant species to enhance therapeutic efficacy [12]. Taxonomic analysis revealed an uneven distribution across plant families, with Zingiberaceae, Lamiaceae, Acanthaceae, and Menispermaceae representing the most prevalent families (each contributing 8.57% of the total species). Verbenaceae, Meliaceae, Musaceae, and Moraceae constituted the second most frequent taxonomic groups (each accounting for

5.71%), while the remaining families exhibited lower representation (2.85% each), reflecting significant botanical diversity in traditional medicinal practices (Figure 2).

Morphological analysis of plant parts utilized indicated a pronounced preference for leaves (65% of preparations), predominantly processed via crushing to extract bioactive juices. Fruits and rhizomes were employed in 8% of formulations, demonstrating markedly lower utilization frequencies compared to leaves. Minor contributions were observed from roots, seeds, whole plants, stems, and fruit peels (collectively <5% per category), as illustrated in Figure 3.

The findings of this study highlight the profound reliance on polyherbal formulations in traditional medicinal practices, particularly in rural regions like Gangachara Upazila, Bangladesh. The documented use of 33 plant species from 23 families to treat 12 distinct ailments underscores the rich ethnopharmacological knowledge held by local Kavirajes. This knowledge is deeply rooted in the cultural and socioeconomic fabric of the community, where access to modern healthcare is limited, and traditional medicine remains a cost-effective and culturally accepted alternative.

3.2. Synergistic Potential of Polyherbal Formulations and Pharmacological Validation

The use of polyherbal formulations, such as the combination of *Curcuma longa*, *Azadirachta indica*, and *Clerodendrum infortunatum* for allergic reactions, exemplifies the synergistic potential of combining plants with complementary pharmacological properties. *Curcuma longa* modulates the Th1/Th2 immune balance [13], *Azadirachta indica* exhibits immunomodulatory effects due to azadirachtin [14], and *Clerodendrum infortunatum* provides anti-inflammatory benefits [15]. This approach aligns with modern pharmacological principles, where multi-target therapies are increasingly recognized for their efficacy in managing complex conditions.

Similarly, the formulation for pox management, combining *Nyctanthes arbor-tristis*, *Vitex negundo*, and *Azadirachta indica*, leverages the antiviral [16], antipyretic [17], and immunomodulatory [18] properties of these plants. Such formulations not only address the symptoms but also target the underlying causes of diseases, reflecting a sophisticated understanding of plant-based therapeutics.

A paste made from *Streblus asper* and *Piper longum* leaves was administered for jaundice in this study. The reported immunostimulatory properties of *Streblus asper* [19] and the hepatoprotective effects of *Piper longum* [20] align with their traditional application in treating liver disorders.

For chronic bronchitis, a formulation of *Ocimum tenuiflorum*, *Zingiber officinale*, and *Nigella sativa* is administered with mustard oil or honey. Similar findings have been reported, indicating that *Ocimum tenuiflorum* enhances lung function through its antioxidant properties [21], while *Zingiber officinale* and *Nigella sativa* exhibit bronchodilatory and anti-inflammatory effects [22, 23].

The combination of *Justicia gendarussa*, *Cissus quadrangularis*, and *Zingiber officinalis* for paralysis underscores their respective neurodegenerative [24], bone-repairing [25], and anti-inflammatory properties [26]. This formulation effectively targets both structural and inflammatory components of the condition.

A combination of *Tinospora sinensis*, *Ficus racemosa* and *Momordica charantia* leaf juice is consumed for the treatment of Diabetes. *Tinospora sinensis* protects pancreatic β-cells [27], while *Momordica charantia's* hypoglycemic effects are validated in clinical meta-analyses [28,29] and. *Ficus racemosa* also shows antidiabetic potential [30].

3.3. Formulation and administration:

The documented formulations provide a foundation for further pharmacological research and drug discovery. The documented formulations predominantly utilize a polyherbal approach, combining multiple medicinal plants to enhance therapeutic efficacy. Various methods were employed in preparing these formulations, including crushing, grinding, drying, and boiling, depending on the intended medicinal application.

This study highlighted some unique formulations in one approach plant pastes were processed into tablets and combined with extracted juices to enhance therapeutic efficacy. For instance, *Azadirachta indica* and *Clerodendrum infortunatum* leaves were ground into a paste, sun-dried into tablets, and consumed with *Curcuma longa* rhizome juice.

In another approach plant ashes were incorporated in certain treatments. The integration of chemical supplements with plant-based remedies was also observed, such as mixing *Musa paradisiaca* ash with calcium hydroxide to form a paste, which was applied to abscesses and covered with a whole *Sida acuta* leaf. These diverse preparation methods highlight

the adaptability of traditional medicine, providing valuable insights into future pharmacological research and its potential integration into modern therapeutic applications.

3.4. Cultural and Socioeconomic Context

The reliance on traditional medicine in Gangachara Upazila is influenced by several factors, including limited access to modern healthcare facilities, financial constraints, and cultural preferences. The use of locally available plants, such as Ocimum *tenuiflorum*, *Zingiber officinale*, and *Nigella sativa* for chronic bronchitis [21,22,23], reflects the community's adaptation to resource limitations. These plants are not only effective but also affordable and accessible, making them a practical choice for rural populations.

3.5. Challenges and Opportunities

Despite the efficacy of traditional medicine, several challenges persist. The knowledge held by Kavirajes is often passed down orally and guarded within practitioner lineages, leading to a risk of knowledge loss over time. Additionally, the lack of systematic documentation and scientific validation of many traditional practices limits their integration into modern healthcare systems.

However, these challenges also present opportunities. The documented formulations provide a foundation for further pharmacological research and drug discovery. For example, the immunomodulatory and antiviral properties of *Nyctanthes arbor-tristis* and *Vitex negundo* could be explored for developing novel therapeutics for viral infections. Similarly, the antidiabetic potential of *Tinospora sinensis* and *Momordica charantia* warrants further clinical studies to validate their efficacy and safety.

3.6. Implications for Healthcare Systems

The findings of this study underscore the need to integrate traditional medicine into national healthcare systems, particularly in resource-limited settings. By combining the strengths of traditional and modern medicine, it is possible to develop holistic, culturally sensitive, and cost-effective healthcare solutions. This integration requires collaboration between traditional practitioners, researchers, and policymakers to ensure the preservation, validation, and sustainable use of ethnopharmacological knowledge.

4. Conclusion

The ethnopharmacological practices documented in this study highlight the therapeutic potential of traditional medicine in addressing a wide range of health conditions. The use of polyherbal formulations reflects a deep understanding of plant properties and their synergistic effects, offering valuable insights for modern pharmacology. However, systematic documentation, scientific validation, and integration into healthcare systems are essential to fully harness the potential of traditional medicine. By bridging the gap between traditional knowledge and modern science, it is possible to improve healthcare delivery and outcomes, particularly in underserved communities.

Compliance with ethical standards

Acknowledgement

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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